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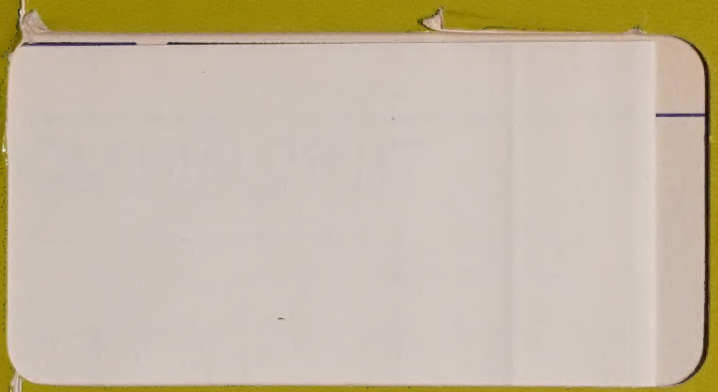

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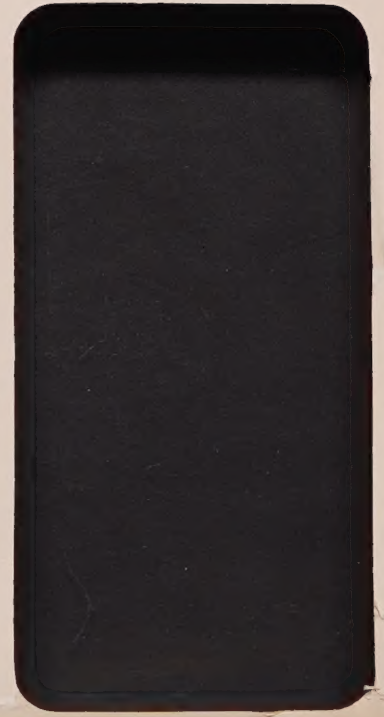

MICROWAVE SIGNAL GENERATOR

TYPE 431/A SERIAL No.18

HANDBOOK

WARRANTY

Flann Microwave Instruments Ltd., warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose and to making good at our factory any part or parts thereof (except tubes, transistors, integrated circuits, batteries, diodes and crystals) which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid and which in our examination shall disclose to our satisfaction to have been thus defective. Warranty returns or repairs must first be authorised by F.M.I. Flann Microwave Instruments Ltd. does not authorise any person to assume for them any other liability in connection with the sale of F.M.I. instruments. Unauthorised tampering with sealed screws may result in damage to the instrument - and will invalidate the warranty.

DESIGN CHANGES

Flann Microwave Instruments Ltd. reserves the right to make changes in the design of its instruments without incurring any obligation to make the same changes on equipments previously purchased.

SPECIFICATION CHANGES

Flann Microwave Instruments reserves the right to change any specification noted herein, without prior notice.

REPAIRS

When returning instruments for repairs, or for any other reason, please contact this Company for shipping instructions. To expedite repair service, it is important to provide type number, serial number and a detailed description of the reason for the return of the instrument.

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SECTION 1

GENERAL DESCRIPTION

The 431/A SIGNAL GENERATOR utilises a precision broad band, high Q, coaxial resonator into which the "GUNN" effect diode is mounted. A mechanically driven tuning piston, actuated by a frequency linearising cam mechanism is coupled to a digital counter and the front panel frequency control. Output power is coupled through a digital readout piston attenuator, isolator and PIN modulator to a SMA type output connector on the front panel.

The microwave signal is available as C.W. or modulated by a variable frequency square-wave or variable deviation frequency modulation. BNC female sockets give synchronising signals and facility to modulate with external signals.

The available power is monitored by a temperature compensated thermistor giving a direct indication of power at the R.F. output connector when used in conjunction with the piston attenuator readout.

SPECIFICATION

FREQUENCY RANGE: 12 to 18 GHz

DIGITAL FREQUENCY READOUT: accuracy better than ±1% below -5dB setting

SMALLEST FREQUENCY SCALE READING: 20 MHz.

POWER OUTPUT: not less than 0dBm between 12 GHz and 18 GHz when correctly terminated in a 50Ω line.

POWER OUTPUT ACCURACY: within ± 3dB between 12 GHz and 18 GHz at -5dBm when terminated in a 50 ohm line. (Between -5dBm and -127dBm piston correction factors must be applied).

VSWR: Typically < 2.5:1 50 ohm impedance.

SMALLEST ATTENUATOR SCALE READING: 0.2dB.

SQUARE WAVE MODULATION

FREQUENCY	400Hz to 4KHz continuously variable dial accuracy ± 25%.
MARK TO SPACE RATIO	1 : 1 ± 5%
R.F. ENVELOPE RISE TIME	0.5 μsec
R.F. ENVELOPE DECAY TIME	0.5 μsec

FREQUENCY MODULATION DEVIATION

RATE	100Hz ± 20%
MAXIMUM	Typically ≮ 50 MHz

EXTERNAL MODULATION REQUIREMENTS

Negative pulse 2 to 10V amplitude

Width 5 μsec to 2 msec

GENERAL

INPUT VOLTAGE	100 to 125 v in 5v steps 200 to 250 v in 10v steps		
MAINS FREQUENCY	50 to 60Hz		
POWER CONSUMPTION	75VA		
SIZE (OVERALL)	Height	Width	Depth
	15.5 cm	48 cm	28.5 cm
	6 ins.	19 ins.	11.25 ins.
WEIGHT	11 Kg 25 lbs.		

SECTION 2

PRINCIPLE OF OPERATION

2.1 MICROWAVE ASSEMBLY

CAVITY ASSEMBLY - The heart of the microwave assembly is a high Q, broad band, coaxial cavity into which a GUNN effect diode is mounted. To vary the resonant length of the cavity and provide continuous frequency coverage, a non-contacting piston is employed. The position of the piston is controlled through a precision drive mechanism from an adjustable frequency linearising cam coupled to the FREQUENCY CONTROL knob and the digital frequency readout on the front panel.

A multi-turn helical potentiometer controls the stabilised D.C. voltage supply to the GUNN diode (providing optimum R.F. output over the full frequency range) and is coupled to the FREQUENCY CONTROL knob and the digital FREQNENCY READOUT on the front panel. The -VE terminal of the GUNN diode supply voltage is connected to the insulated inner conductor of the cavity. The +VE terminal which is earthed, is connected to the body of the cavity. The voltage is typically 7·5 volts at the high frequency end and changes linearly to a maximum of 9·1 volts at the low frequency end.

PISTON ATTENUATOR - The R.F. energy from the cavity is coupled into a precision electroformed circular waveguide operating in an evanescent TM_{01} mode and is then picked up by a variable position probe. The position of the probe is controlled by the ATTENUATOR knob and indicated on the ATTENUATION digital readout. The parameters of the piston attenuator have been chosen such that the ATTENUATION digital readout is a direct display of the relative microwave power level in decibels. However, for measurements of the highest accuracy (because such attenuators are frequency dependent) it is necessary to use a frequency correction factor tabulated in section 4 paragraph 6.

ISOLATOR - A miniature, broad band ferrite isolator is incorporated in the R.F. line to minimise frequency pulling.

PIN MODULATOR - Direct amplitude modulation of the GUNN diode results in excessive frequency modulation of the signal, therefore a PIN MODULATOR is fitted between the piston attenuator and the R.F. output socket. The GUNN oscillator operates in the C.W. condition and the square wave or pulse modulation is applied to the PIN MODULATOR. With a negative voltage applied to the PIN diode, the diode is back biased and presents little attenuation to the signal. When a positive bias is applied, the diode conducts and presents high attenuation to the signal. The off to on attenuation is usually greater than 20dB.

The forward resistance of the diode is of the order of 50 ohm (dependent on the current passing) and the back resistance is greater than 10 megohm. When checking the diode, the back bias voltage must not exceed 15 volts and the forward current must not exceed 100mA.

POWER MONITOR - The power monitor circuit consists of a 15 volt regulated D.C. supply, a 50 cycle square wave regulated supply, a temperature compensating thermistor type KB13 (mounted on the GUNN oscillator cavity) the thermistor bridge (including the panel meter) and the measuring thermistor mounted in the R.F. cavity and forming one arm of that bridge.

A change in ambient temperature results in a change of resistance of the temperature compensating thermistor which in turn adjusts the amplitude of the square wave voltage supplied to the thermistor bridge; this temperature compensating circuit in conjunction with the POWER METER ZERO SET control will maintain the balance of the bridge at the ZERO SET position of the MODULATION switch.

For the other positions of the MODULATION switch the microwave energy in the cavity will heat up the measuring thermistor and cause an unbalance in the bridge. The unbalance is proportional to the available power in the cavity and is indicated on the dBm meter.

2.2 MODULATORS

Square Wave Generators The design features the well-known monolithic timing circuit of the '555' family (MC 1455 or equivalent) connected in the astable mode. In this mode the timer retriggers itself and oscillates between 1/3 and 2/3 Vcc. In order to obtain an accurate 1:1 mark-to-space ratio and at the same time to control the frequency in a linear manner, the timing capacitor is charged and discharged through two constant current circuits formed by Q4 and Q5. These transistors are controlled by Q3. Temperature compensation is effected by transistor Q2. The resultant waveform is applied to the PIN diode via R34 so as to limit the forward current to about 15mA. The waveform, via a buffer resistor 10 KΩ, is also fed to the SYNC output socket.

Sawtooth Generator A timer circuit I.C.3, based on the type '555', is employed to produce the sawtooth required for F.M. (Frequency Modulation). The circuit works in the astable mode but the capacitor discharge is rapid. The capacitor waveform is applied to an emitter follower stage comprising transistor Q6 and Q7. From here the waveform is A.C. coupled to a potentiometer which determines the amount of F.M. The required amount of sawtooth is then applied to pin 6 of the voltage regulator circuit, thus causing the Gunn Diode supply to be swept about its average (C.W.) potential.

Ext. Modulation External negative going pulses of duration between 5 microsec and 2 millisec may be applied to the PIN diode. The pulses are amplified in the circuit comprising transistor Q1. Use is then made of the internal circuit of the Timer I.C.6 to shape the pulses and apply them to the PIN diode.

C.W. The PIN diode has a steady reverse bias applied to it.

2.3 POWER SUPPLIES

Variable Voltage (6-13 V) GUNN DIODE Supply The A.C. mains derived sinewave is rectified in a bridge rectifier. This is followed by a reservoir capacitor C101. Stabilisation is achieved by means of a monolithic regulator of the '305' type and a series transistor Q101 driven by Q102. Fuse F5 acts as a current sampling resistor. Should the current become excessive, the mode of operation will change from constant voltage to constant current. The nominal design value of the current limit is 3A.

F.M. Modulation of the Gunn Diode is achieved by sweeping the supply at a rate of 100 Hz with a sawtooth waveform.

FIXED +15V SUPPLY TO POWER METER - A supply similar to that described under the heading 6 to 13V provides +15V to the R.F. power measuring circuit and to the sawtooth generator. Half-wave rectification is used so that the same A.C. supply can be used to produce a 50 Hz square wave as described below.

50 Hz SQUARE WAVE SUPPLY AND POWER METER The power meter circuit is based on a conventional Wheatstone bridge where an R.F. sensing thermistor forms one of the arms of the bridge. In this way the bridge sensitivity is essentially independent of temperature. To produce the 50 Hz square wave transistor T105 is driven hard on and off by the same A.C. supply wich after rectification and stabilisation produces the +15v. The collector load of T105 comprises the Set Zero potentiometer and a temperature compensating thermistor K8 13. The waveform from the slider of the Set Zero potentiometer is applied to the bases of an p.n.p. - n.p.n. output pair T106 and T107. The buffered output from the common emitters of these two transistors is condenser coupled to the power meter bridge thus supplying the required A.C. bias.

SECTION 3

OPERATING CONTROLS. READ-OUTS AND CONNECTORS

3.1 CONTROLS

(a) MODULATION

EXT. MOD.	At the EXT MOD position the width and rate of the R.F. OUTPUT pulse is that of an external amplitude modulation pulse of negative polarity applied to the EXT. MOD IN socket.
POWER METER ZERO SET	At this position the R.F. power is switched off so that the POWER METER zero set control may be used to adjust the meter reading to SET ZERO.
C.W.	At the C.W. position an unmodulated R.F. signal is obtained.
⎍⎍⎍	At this position the R.F. output of the instrument is modulated by a 1 to 1 square waveform whose frequency is determined by the position of the ⎍⎍⎍ FREQ. KHz control.
F.M.	At the F.M. position a sawtooth voltage is applied directly across the Gunn device giving a frequency modulated R.F. signal.

(b) F.M. DEVIATION — Adjusts the F.M. DEVIATION when the modulation switch is set to F.M.

(c) ⎍⎍⎍ FREQ.KHz — Adjusts the repetition frequency. When the MODULATION Switch is set to ⎍⎍⎍ the frequency is variable between 400 Hz to 4 KHz.

(d) POWER METER ZERO SET — Sets the power meter to its SET ZERO (NO R.F. POWER) reference.

(e) SUPPLY OFF — This switch interrupts the supply into the instrument.

(f) FREQUENCY GHz — Selects the output carrier frequency which is displayed on the digital readout.

(g) ATTENUATION -dB — Attenuates the output power according to the digital readout setting.

3.2 READ-OUTS

(a) FREQUENCY GHz — Direct display of output carrier frequency.

(b) ATTENUATION dB — Direct display of attenuation in decibel.

(c) METER — Direct indication of microwave power available at R.F. output socket in dBm, when added to the attenuator setting.

CONNECTORS

(a)	R.F. OUTPUT	Type SMA Female at which there appears the R.F. OUTPUT from the piston attenuator.
(b)	EXT. MOD. IN	BNC Female A.C. coupled, for incoming negative external modulation, when the MODULATION switch is set to EXT. MOD. (see EXT. MOD. requirement).
(c)	⎍⎍⎍ SYNC.OUT.	BNC Female providing a square wave output suitable for synchronising oscilloscopes etc., when the instrument is operating in the square-wave mode. This socket must not be connected to a circuit carrying D.C. or other waveforms.
(d)	F.M. SYNC.OUT.	BNC Female providing a pulsed output suitable for synchronising oscilloscopes etc., when the instrument is operating in the F.M. mode. This socket must not be connected to a circuit carrying D.C. or other waveforms.

SECTION 4

OPERATING INSTRUCTIONS

4.1 SWITCHING ON PROCEDURE

(a) The instrument leaves the factory with the mains transformer connected for 230 volts A.C. operation. If it is required to use other voltages the transformer must be re-connected inside the case. The transformer features two identical primary windings which are suitable for series/parallel operation, i.e. in the case of the nominal 115 volt mains, the two 'zeros' are linked together and are connected to one side of the mains whilst the two 115 volt taps are linked to the other side of the mains. For 230 volt operation the 'zero' of one primary connects to 115 volt tap of the other primary. Other voltages between 200 and 250 volts or 100 and 125 volts may be chosen in a similar way.

NOTE: It is essential to remember that the two windings must be paired up with identical tappings.

To facilitate access to the transformer, the upper three 4BA screws securing the handles on each side of the instrument case must be removed. The instrument cover may now be lifted clear, displaying the transformer, cavity mechanism and circuitry.

(b) Connect the mains cable to the mains supply (green/yellow = earth). Switch the instrument ON.

4.2 C.W. OPERATION

(a) Set the FREQUENCY GHz control to the desired output frequency.

(b) Set the MODULATION switch at POWER METER ZERO SET and adjust the POWER METER zero set control until the meter reads exactly on the SET ZERO marking.

(c) Turn the MODULATION switch to C.W. At this stage C.W. power is available at the R.F. OUTPUT socket.

NOTE: To allow for warm up of the instrument it is advisable to repeat (b) and (c) after the instrument has been running for 5-10 minutes.

(d) The level of C.W. power available in dBm at the R.F. output socket is obtained by adding the meter reading, in dB, to the value of the attenuator readout setting in -dB. The output level is calibrated to an accuracy of $\pm$ 3dBm between -5 and -127dBm into a 50 ohm load.

EXAMPLE: Power Meter Reading + Attenuator Readout = actual R.F. output.

(+2dB)	+	(-15dB)	=	-13dBm
(-2dB)	+	(-20dB)	=	-22dBm

4.3 MODULATION WITH AN EXTERNAL PULSE VOLTAGE

The external negative pulse must be between 2V and 10V amplitude, 40Hz to 4KHz, 5 μsec to 2 msec duration. Connect a video cable carrying the above voltage to the connector marked EXT. MOD. IN. Position the MODULATION switch to EXT. MOD.

4.4 SQUARE WAVE MODULATED OPERATION

If it is desired to operate the signal source with square wave modulation, turn the MODULATION switch to ⎍⎍ and set the FREQUENCY control to the desired rate. A synchronising signal is available at the SYNC. OUT connector.

4.5 FREQUENCY MODULATED OPERATION

The R.F. output can be frequency modulated by setting the MODULATION switch to the F.M. position and this applies a sawtooth voltage to the Gunn diode. The sawtooth amplitude, hence the frequency deviation, can be adjusted by varying the F.M. DEVIATION control. A pulsed waveform is available at the SYNC. OUT connector.

4.6 ATTENUATOR OPERATION

The parameters of the piston attenuator are such that the ATTENUATION digital readout is a direct indication in decibels of the relative mocrowave power at the R.F. output socket. However, because of the inherent frequency sensitivity of such attenuators, for high accuracy measurements it is necessary to refer to the correction factor table.

NOTE: Attenuation at high frequency is less than that indicated on the digital readout.

ATTENUATOR CORRECTION FACTOR TABLE

FREQUENCY GHz	CORRECTION FACTOR
7	1.002
8	1.000
9	.999
10	.993
11	.989
12	.984
13	.979
14	.974
15	.969
16	.963
17	.956
18	.949

True attenuation = attenuator reading x correction factor.

EXAMPLE: FREQUENCY READOUT SET TO 12GHz

Attenuator Readout moved from -15dB to -35dB setting.
Actual attenuation may be determined as below:

$(-15) - (-35) \times .984$

$20 \times .984 = 19.68dB$

NOTE: Depending on the VSWR of the load presented to the R.F. output socket in the region of the 0dB setting of the ATTENUATION readout, inaccuracies in measurements may occur due to over-coupling and frequency pulling. Care should also be taken when using the attenuator from 0dB to -15dB due to the inherent non-linear operating range of piston attenuators.

4.7 SWITCHING OFF PROCEDURE

(a) The R.F. output can be switched off by setting the MODULATION switch to POWER METER ZERO SET.

(b) All supplies are interrupted by operating the MAINS switch.

SECTION 5

MAINTENANCE

INTRODUCTION

If a Signal Generator fails within the guarantee period the instrument must be returned to the manufacturer for rectification. Any attempt at rectification on the part of the user without authority from the manufacturer will invalidate the guarantee.

If a Signal Generator fails outside the guarantee period it is recommended (because of the complexity of the Generator and critical adjustment of its components) that the instrument should be returned to the manufacturer for correction. However, if it is not practical to return the instrument to the manufacturer, the following FAULT ANALYSIS SCHEDULE should be followed carefully so the fault may be identified. No attempt must be made to dismantle any of the microwave components.

5.1 REMOVAL OF THE INSTRUMENT CASE

(a) Switch off the supply to the instrument and disconnect the input cable from the supply.

(b) Remove the upper three 4BA screws securing the handles on each side of the instrument case.

(c) Lift the upper half of the instrument casing to display the microwave assembly, supply transformer and circuitry.

5.2 TEST EQUIPMENT

When servicing a Signal Generator the following test equipment will be required:

(a) High impedance general purpose volt ohm meter (Model 8 avometer).

(b) D.C. oscilloscope with sensitivity of 10 millivolts per centimetre.

(c) Frequency meter

(d) Crystal holder with SMA type Microwave Connector.

(e) Power meter and associate Thermistor Head

(f) Selective audio amplifier

(g) 3 Watt 50 ohm resistor

(h) Soldering Iron

CAUTION: At no time should the unit be switched on without the tracking potentiometer connected in circuit.

Before any electronic servicing is carried out on the Signal Generator, a 50 ohm, 3 watt resistor must be connected in place of the oscillator cavity.

5.3 FAULT ANALYSIS SCHEDULE

(a) Set Frequency Readout to Mid Band and Modulation switch to C.W. Switch Signal Generator on and with Attenuator set to -10dB, connect the R.F. Power Meter to the R.F. output connector and check the R.F. output power.

(b) Adjust the attenuator over as wide an attenuation range as is practical and observe the output signal (at tight coupling, overcoupling and frequency pulling may occur). If signal changes erratically see Paragraph 5.4(b).

(c) If no R.F. Power is available disconnect the R.F. connection between the Piston Attenuator and the PIN Modulator and check power out of Piston Attenuator. If no power is present see Paragraph 5.3(f);if power is present see paragraph 5.3(d).

(d) Check the voltage on the PIN Modulator: this should be approximately -6V. If there is no negative voltage, disconnect the wire from the PIN Modulator and check the voltage on the wire. If there is no voltage, check and remedy the electronic circuitry. Check PIN Modulator with reference to paragraph 5.4(a).

(e) If the PIN Modulator is functional, re-connect wire and re-connect the R.F. connection between PIN Modulator and the Piston Attenuator and re-check the R.F. output at the SMA output connector.

(f) Check the voltage to the cavity. (This should be 8·5 volts approximately). Adjust Frequency control over full range of unit. The voltage should change smoothly from about 7·5 volts at high frequency to not greater than 9.1 volts at the low frequency. If there is no voltage, or voltage changes erratically, disconnect the wire to the Oscillator Cavity and connect to a 50 ohm, 3 watt Resistor, then check and remedy the electronic circuitry - refer 5.4(d).

(g) Before re-connecting the Oscillator Cavity, check the D.C. resistance of the Cavity Oscillator as in paragraph 5.4(c). If the voltage to the Cavity is correct but there is no R.F. power, the Cavity is faulty. Check as in paragraph 5.4(c) and replace Gunn Diode if necessary.

5.4 COMPONENT CHECK AND REMEDIES

(a) PIN MODULATOR: For a full assessment of the PIN MODULATOR, a microwave check of VSWR and attenuation with ON/OFF applied bias should be carried out. On the other hand a simple resistance check with an ohmmeter should reveal possible faults. The resistance between the two inner conductors of the SMA connectors should be 0 to 0.5 ohm. The resistance between the two SMA inners and outer case should be 2 to 3 ohm. The forward resistance of the diode (+ve applied to pin is very dependent on meter range used and is approximately 50ohm). The backward resistance should be greater than 10 megohm.

DO NOT exceed 100mA. of forward current or 15 volts of reverse voltage.

If the PIN MODULATOR is faulty, disconnect the unit from the Signal Generator, carefully pack and return to the manufacturer for repair.

(b) PISTON ATTENUATOR. Disconnect the Piston Attenuator from the Isolator. The resistance measured at the male output connector of the attenuator should be greater than one megohm. For a faulty attenuator, return the Signal Generator to the manufacturer for repair and re-alignment.

(c) OSCILLATOR CAVITY. A cavity with a GUNN DIODE mounted in it measures approximately the same resistance either way and is of the order of 10 to 50 ohm.

An incorrectly mounted diode could result in resistance fluctuations with FREQUENCY tuning. The resistance of the cavity without the diode and with SKI disconnected should be greater than 10,000 ohm. (For removal of GUNN diode, refer to section 5, paragraph 7). For a faulty cavity return the Signal Generator to the manufacturer for repair and re-alignment.

(d) TRACKING POTENTIOMETER. The 10K ohm ten turn tracking potentiometer should have smooth resistance variation over its full travel. If the potentiometer is faulty, return to the manufacturer for a replacement. When replacing a potentiometer, connect a 50 ohm, 3 watt resistor in place of the oscillator cavity and check across the resistor that the voltage increases smoothly with frequency tuning from approximately 7.5 at the high frequency to maximum value of 9.1 volts at the low frequency.

5.5 REMOVAL OF MICROWAVE ASSEMBLY

(a) Remove the ATTENUATOR and the FREQUENCY GHz controls from the front panel.

(b) Remove support pillar under cavity assy.(6 B.A.)

(c) Disconnect SK 1 on the microwave assembly.

(d) Disconnect the R.F. cable between the Isolator and the PIN modulator at the PIN modulator.

(e) Remove the four 2BA pan head screws on the front panel.

(f) Carefully remove microwave assembly.

5.6 REMOVAL OF GUNN DIODE

(a) Once the cavity mechanism has been removed from the case, it should be placed inverted on a white clear surface (the readouts upside down).

(b) The top cap of the diode assembly will be seen as a plated cap, directly above FREQUENCY GHz readout. At this stage reference to Figure 1 will assist the operation.

(c) The rear of the assembly should be raised so that the angle made to the horizontal is approximately 30°, to prevent the crinkle washer from falling inside the cavity. The top cap may now be unscrewed withdrawing the pressure sleeve, the heat sink contact, the GUNN diode and the crinkle washer from the cavity. If any of these items are left in the cavity, they should be removed carefully with tweezers.

GUNN DIODE REPLACEMENT

(a) When a replacement Diode is required, either the instrument should be returned to the manufacturer or an order with date of purchase, serial number and type be forwarded to the manufacturer so a Diode whose characteristics are closest to the original may be selected for the instrument.

(b) Before replacing the diode it is advisable that the D.C. supply voltage should be checked and that on tuning the cavity there is no erratic effect throughout its range. (Refer paragraph 5.3(f)).

INSTALLING THE REPLACEMENT DIODE

(a) When installing a diode the POSITIVE TERMINAL should be engaged HALF WAY into the heat sink contact (See figure 1).

(b) The heat sink contact may now be slipped inside the pressure sleeve and this assembly placed in the end cap.

(c) The crinkle washer should now be positioned on the NEGATIVE TERMINAL of the Diode. The mounting assembly is now ready to be fitted to the cavity. The rear of the mechanism unit should be raised to approximately 30° to the horizontal, to ensure the crinkle washer remains on the diode whilst the mounting assembly is introduced into the cavity and screwed home securely.

(d) The steps listed in Section 5 paragraph 5 should now be re-traced and the MICROWAVE ASSEMBLY re-mounted in the electronics chassis.

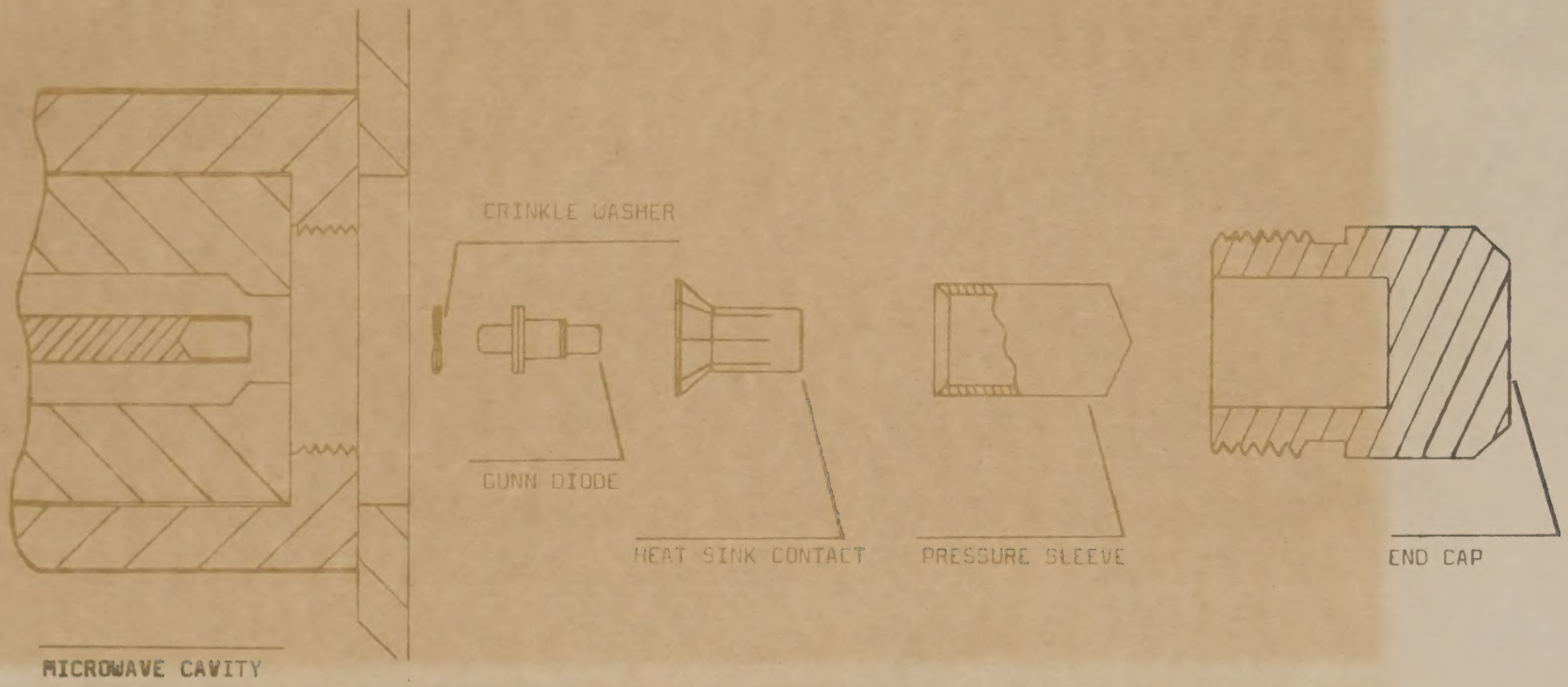
FREQUENCY RE-CALIBRATION OF SIGNAL GENERATOR

(a) Connect a frequency meter to R.F. output socket.

(b) Adjust FREQUENCY control so that the roller bearing on the cavity drive mechanism coincides with one of the 6BA screwed adjusting rods on the frequency linearising cam.

(c) Adjust the two 6BA nuts so that the frequency of the R.F. OUTPUT agrees with the frequency readout setting.

(d) Repeat the above at each frequency that the roller bearing is coincident with one of the 6BA adjusting rods on the frequency linearising cam.



GUNN DIODE MOUNTING ASSEMBLY

FIG 1